REMARKS/ARGUMENTS

I. Status of Claims

Claims 1-52 are pending in this application. Claims 1-25 and 38-52 have been withdrawn. Claims 53-64 have been added. Claims 26, 27-32, 34-36 have been amended. Claim 33 has been cancelled. In light of the above amendments and the following remarks, Applicant respectfully requests reconsideration and allowance of this application.

A. Overview

The present invention offers a method for separating liquid components of differing densities from a fluid mixture. One example of a fluid mixture to be separated would be a mixture of oil and water produced from a subterranean reservoir. The fluid mixture is first conditioned or coalesced by a flow coalescing apparatus and then separated by a liquid separator apparatus. The efficiency of the liquid separator apparatus is enhanced if the water and oil mixture is at least partially coalesced into droplets as opposed to being further sheared apart by the flow coalescing apparatus. In one embodiment of this invention, the method of using the flow coalescing apparatus includes controlling the rate of flow through the flow coalescing device while encouraging droplet creation and minimizing droplet shearing and dispersion. Conventional chokes are notorious for shearing and dispersing fluid mixtures passing through the choke. The flow coalescing apparatus uses a swirl chamber in which the fluid mixture is swirled to induce droplet formation. Further, the coalescence may be aided by providing an inlet and/or outlet which is designed to minimize fluid shear. This may be enhanced

by providing orifices of a proper shape. Also, by shaping orifices to direct fluids both circumferentially and downstream, fluid shearing is minimized. The claims currently in this application define methods of accomplishing these goals which are not found or suggested by the cited prior art.

II. Objections and Rejections of Claims

A . Objection to the Title

The Examiner has requested that the title be changed as a number of the claims directed to a system and to a flow conditioning apparatus have been withdrawn. Applicant has amended the title to coincide with the Examiner's request, with the exception that "conditioning" has been changed to "coalescing". As a swirl chamber is used to helically swirl a fluid mixture and induce droplet coalesce, the term "coalescing" more appropriately describes the action in the swirl chamber.

B. Objection to the Drawings

The Examiner has objected to the drawings under 37 CFR §1.83(a). In particular, the Examiner has objected to claims 35 and 36 which generally call for an inlet opening containing a plurality of orifices and an outlet including a plurality of orifices inlet openings. The Examiner suggests that an inlet opening containing a plurality of orifices or an inlet including a plurality of inlet openings is not shown in the drawings.

Claims have been amended to call for a swirl chamber having an inlet and an outlet. The inlet and outlet may include a plurality of orifices. FIGS. 10A and

10B clearly illustrate a plurality of orifices 806 and 810 in outer casing 802 and inner production tubing 804. Together, these inner and outer cylindrical walls form an annular swirl chamber. FIGS. 10A and 10B include an arrow showing how fluid entering the inlet orifices and exiting the outlet orifices induce swirling in the annular swirl chamber.

Further, FIGS. 2B, 2D, 3A, 3B, and 3D show a plurality of orifices used to provide fluid communication relative to a swirl chamber. In this case, it happens to be an outlet from a swirl chamber. However, one skilled in the art would readily appreciate that essentially identical orifices could have been utilized as an inlet to the swirl chamber, particularly in light of FIGS. 10A and 10B.

Applicant respectfully traverses the objection to the drawings. The drawings presently in the application clearly enable one skilled in the art the practice the methods recited in the pending claims. The Examiner is asked to withdrawn his objection to the drawings in light of the claim amendments which refer to inlets and outlets and to the many examples of a "plurality of orifices" shown in numerous drawings.

C. Rejection Under 35 U.S.C. §112, 1st Paragraph

The Examiner has rejected claim 35 under 35 U.S.C. §112, as the application "does not reasonably provide enablement for the inlet opening including a plurality of orifices." Claim 36 has been rejected for similar reasons as the "claim contains subject matter which was not described in the specification in such a way as to enable one skilled in the art . . . to make and/or use the invention."

Again, FIGS 10A and 10B clearly illustrate a plurality of orifices 806 and 810 in outer casing 802 and inner production tubing 804. Fluid flowing into the annulus formed between these cylindrical walls is induced to swirl or move circumferentially and axially upwardly. The formation of a plurality of orifices in a cylindrical member, as shown in particular in FIGS. 2D and 2E, along with the accompanying description in the specification, clearly describes to one skilled in the art how such a "plurality of orifices" may be created.

Pages 16-17, lines 24-30 and lines 1-6 provide:

Orifices 226 are arranged in a spiral manner relative to swirl axis 211. These orifices 226 are formed by drilling tangentially to the inner surface of inner cylinder 206 (FIG. 2E) and at angle θ (FIG. 2D) relative to a plane perpendicular to swirl axis 211. Angle θ may range from 0-90°, more preferably from 0-30°, and most preferably at 5-15°. Ideally, fluid passing through orifices 226 will be angled downstream such that the incoming liquid follows closely along the streamlines of the internal flow. Orifices 226 are generally circumferentially extending relative to the inner wall, as compared to radially directed toward the swirl axis 211, and their peripheries are elliptical or are oblong and curved in shape. This enlarged periphery is helpful in producing larger droplets exiting from orifices 226 as compared to circular orifices which would open and extend radially toward swirl axis 211 and are oriented at angle θ = 0°. (See FIGS. 3D and 3E.)

As a practical matter, Applicant believes that one skilled in the art would have little, if any trouble, in creating inlet and outlets comprising a plurality of orifices in view of the detailed description and drawings of these pluralities of orifices found throughout the specification and drawings.

Applicant respectfully asks the Examiner to reconsider and withdraw these rejections regarding enablement under 35 USC §112, 1st paragraph with respect to creating or using "a plurality of orifices" as inlets or outlets to a swirl chamber.

D. Rejection Under 35 U.S.C. §102(b)

The Examiner has rejected claims 26-28 and 33 as being anticipated by Sams et al. Claim 26 has been amended such that the flow conditioning apparatus used to practice the method of claim 26 now includes a "flow control mechanism adjustably controlling the rate of flow through the flow coalescing apparatus while the fluid mixture is helically swirled within the swirl chamber about a swirl axis to induce droplets of at least one of the liquid components to coalesce;" The allows the flow coalescing apparatus to act as a choke, with minimal dispersion effects on fluid passing therethrough, upstream from a device that actually performs the separation. Conversely, conventional chokes are known which create significant fluid shearing which would be adverse to the performance of a downstream separator.

Sams et al. fails to teach a method of using a flow coalescing apparatus having "a flow control mechanism adjustably controlling the rate of flow" through the flow coalescing apparatus while simultaneously coalescing the fluid flowing therethrough by swirling the fluid. The Examiner is asked to withdraw his rejection under 35 U.S.C. §102 in light of the amendment to claim 26. For similar reasons, rejections under 35 U.S.C. §102 for claims dependent upon claim 26 are requested to be withdrawn as well.

E. Rejections under 35 U.S.C. §103(a)

1. Rejection of Claim 29

Claim 29 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Sams et al. in view of Hesse et al. As described above, Sams et al fails to teach a method using a "flow coalescing apparatus" having a "flow control mechanism." Hesse et al. is not a flow coalescing device for conditioning the fluid mixture passing therethrough. Rather, Hesse et al. is a hydroclone which is designed to separate components of a fluid mixture rather than coalesce the fluid mixture prior to forwarding the coalesced fluid mixture to a fluid separator. Note that in the present invention, the flow coalescing apparatus does not require separate outlets and outlet conduits for an oil stream and a water stream – rather, the entire flow passes into and out of the flow coalescing apparatus without a portion of the fluid mixture being split.

Hesse et al. also fails to teach a "flow control mechanism" for controlling the flow of a fluid mixture passing through a flow coalescing apparatus. Hesse et al. shows a pair of parallel and distinct hydrocyclone separators for separating water from oil.

For these reasons, Applicant respectfully asserts that the teachings of Sams et al., in light of Hesse et al., fail to teach the invention recited in the claims, as presently amended, including amended claim 29.

2. Rejection of Claims 26-36

Claims 26-36 are rejected under 35 U.S.C. §103(a) as being unpatentable over Bohaychuk et al. in view of Schmidt et al. Applicant respectfully traverses this rejection.

Bohaychuk et al. teaches a choke valve for throttling fluid flow. The Examiner suggests that main bore 3 of Bohaychuk et al. operates as a "swirl chamber". However, the "swirling" in this chamber would be turbulent and would not helically swirl about a swirl axis as called for in independent claim 26. Consequently, droplet dispersion rather than coalescence is likely to occur when passing through the choke.

Note in the present invention that tests were conducted for flow conditioning devices which control fluid flow while inducing swirling to promote coalescence. FIGS. 2C shows a cross-section of a fluid conditioning device made in accordance with the present invention and the induced swirling of a fluid mixture passing therethrough. FIG. 3C shows a fluid conditioning device which likely will not induce helical swirling about a swirl axis. FIGS. 5A and 5B show the enhancement to liquid separation by a separator apparatus located downstream from a flow coalescing apparatus which helical swirls a fluid mixture as compared to a flow conditioner apparatus which splits the fluid mixture into separate flow streams which are then rejoined with the flow streams colliding together.

Note that the flow pattern in FIG. 3C of the present application is similar to that of Bohaychuk et al. FIGS. 2-5. Fluid flow is split into separate streams which are then allowed to collide together when reuniting into a single flow stream. This is

an example of the type of choke and fluid flow the present invention is seeking to overcome in providing enhanced coalescence to a downstream separator. Note the rapid change in direction of the fluid flow as it passes through the choke of Bohaychuk et al., as compared to the relatively smooth flow path provided with the method and apparatus of the present invention.

Schmidt et al. teaches a choke 28 upstream from a separator 32. However, there is no teaching that choke 28 helically swirl a fluid mixture passing therethrough to coalesce rather than shear droplets of oil and water. Consequently, Schmidt et al. fails to teach how to overcome the deficiencies of the choke of Bohaychuk et al. to arrive at the advantageous results provide the present invention.

3. Rejection of Claim 37

Claim 37 is rejected under 35 U.S.C. §103(a) as being unpatentable over Bohaychuk et al. in view of Schmidt et al. as applied to claims 26-36 above, and further in view of Bouldin et al.

The Examiner cites Bouldin et al. as suggesting that chokes are commonly used down hole in a wellbore. However, Bouldin et al. still fails to overcome the shortcoming of Bohaychuk et al. and Schmidt et al. That is, none of these references, individually or in combination, teaches a flow coalescing apparatus to induce coalescence of droplets through helical swirling while also adjustably controlling the rate of flow of a fluid mixture through the flow coalescing apparatus. For these reasons, Applicant respectfully traverses this rejection as well.

F. Addition of Claims 53-64

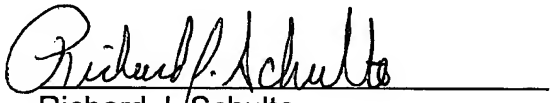
Independent Claim 53 has been added. Claim 53 recites the limitation that "the cylindrical wall including at least one of an inlet and an outlet which are configured to direct fluid flowing therethrough both circumferentially about the swirl axis and downstream at an acute angle θ relative to a plane perpendicular to the swirl axis . . . ." None of the cited references, individually or in combination, teach this feature.

The present method seeks to enhance coalesce of droplets and minimize droplet dispersion. This is, in part, accomplished through minimizing changes in the flow direction of the fluid mixture being conditioned through helical swirling. Rather than directing a fluid mixture into a plane perpendicular to a swirl axis, the method of claim 53 provides that an inlet or outlet direct the fluid flow at an acute angle to a plane perpendicular to the swirl axis. Therefore, the inlet or outlet will direct the fluid flow to have both a circumferential component (to create centrifugal forces on the fluid mixture) while minimizing the change in axial direction of the fluid mixture entering or exiting the swirl chamber. Thus the natural flow induced by the configuration of the inlet or outlet is a helical flow rather than a strictly circumferentially directed flow. FIG. 2D of the present application illustrates how an orifice may be formed to provide this axial component as compared to creating an orifice which directs fluids to pass strictly perpendicular to the swirl axis.

III. Request for Allowance

In light of the above amendments to the specification and claims and the discussion provided in the Remarks, Applicant hereby respectfully requests that this application be passed to allowance. If the Examiner has suggestions which would more quickly advance this application to allowance, then Applicant asks that the Examiner contact the undersigned by phone.

Respectfully submitted,



Richard J. Schulte
Attorney for Applicant
Reg. No. 35,350
(925) 842-1476

RJSchulte:ncc

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